J. mar. biol. Ass. U.K. (1960) 39, 91–99
Printed in Great Britain

A NOTE ON *DALLINA SEPTIGERA* (LOVÉN), (BRACHIOPODA, DALLINIDAE)

By D. ATKINS, D.Sc.
From the Plymouth Laboratory

(Plate I and Text-figs. 1–5)

The discovery of a homoeomorph, *Fallax dalliniformis*, of *Dallina septigera* (Lovén) dredged with that species (Atkins, 1960) and, it is believed, sometimes confused with it, certainly by Fischer & Oehlert (1891), has made a brief redescription desirable. During the present work more than a hundred *D. septigera* of shell length 5–31 mm have been obtained, and most of them examined internally.

The original description in Latin—without figures—of *Dallina septigera* (= *Terebratula septigera*) was by Lovén in 1846 (p. 183). Unfortunately his description does not now clearly separate his species from *Fallax dalliniformis*, except perhaps his failure to mention the presence of dental plates, pedicle collar and spiculation. It is doubtful how much weight can be attached to this, for on the same page he failed to mention the presence of dental plates in *Macandrevia cranium*. He gave the length as 28 mm, width as 21·5 mm and depth as 17 mm.

The Stockholm Natural History Museum, the most likely Museum to possess Lovén's type specimen, unfortunately does not have it, and it is probable that he did not designate one. The Museum, however, does possess old collections of dried shells of this species from Norway and the North Sea, which Lovén probably studied. Through the kindness of Dr H. Mutvei a large specimen from these was loaned to me: he stated that it is not known with certainty whether it was collected before or after 1846—the date of publication of Lovén's paper. This specimen (Pl. I, fig. 2A–D), of length 29 mm, width 22 mm and depth 18 mm, has no dental plates; the pedicle collar is a narrow rim, slightly more marked than in some of the *Dallina septigera* dredged by R.V. 'Sarsia'. The loop is attached to the crura only and is somewhat stouter than in my specimens of about the same size. The ascending branches are wide, narrowing abruptly to the transverse band, which is deeply embayed anteriorly, and less so posteriorly. The band is narrower (antero-posteriorly) than in the majority of 'Sarsia' specimens, in which it generally resembles that figured by Sars (1878, Tab. 1, fig. 2*g*): the depth of the band, however, is variable. The inner hinge plates form a V with the septum. Dr Mutvei mentioned that the shells comprising these old collections have similar external shape.

Gray (1853, p. 59) was the next to describe *D. septigera* under the name *Waldheimia septata*. He seems to have given an abstract of Lovén's description with the same shell measurements: he also failed to provide figures.

In 1855 (p. 441) Davidson described *D. septigera* from a single specimen originally in the possession of S. Hanley, and gave figures of the dorsal, lateral and frontal views of the entire shell. These figures show the typical shape of the beak and pedicle opening of the species, and his failure to mention dental plates makes it almost certain that he had it. His statements that the deltidium was in two pieces and the beak ridges well defined would seem to be errors.

Dall in 1871 was apparently the first to give a figure of the loop, and from this it is obvious that he was dealing with *D. septigera*. His figure clearly shows that in the adult the loop was attached to the crura only, it also shows the V-shaped junction of the inner hinge plates with the septum. He stated: 'hinge plate longer than wide, anterior point passing forward between the crura'. He gave the length as 1·20 in., width as 1·10 in. and depth as 0·80 in., and mentioned that this large specimen originated from Jeffreys. Although he does not refer to the absence of dental plates in *D. septigera* he (1921, p. 359) remarked of *D. floridana* 'there are no props to the dental plates', apparently meaning no props to the teeth.

Friele (1877) described certain of the growth stages of the loop of *D. septigera*. That he had this species appears certain, for he figured the inner hinge plates running in a V to the septum and showed a young stage (size not given) in which the branches of the loop were free from the septum, thus distinguishing it from *Fallax dalliniformis*. The crura in his specimens—drawn with camera lucida—have the appearance of being somewhat shorter than in the 'Sarsia' *Dallina septigera*.

Jeffreys (1878, pp. 407–9) described *D. septigera* under the name *Terebratula septata* Philippi. He noted that in the full grown state the loop is attached only to the hinge plate: from this it is clear that he had *D. septigera*. His specimens, the largest of which was an inch and three-tenths long, were obtained by the 'Porcupine' expeditions. The dredgings in the Western Approaches to the English Channel from which Jeffreys obtained some of his specimens were near the positions where R.V. 'Sarsia' dredged, it therefore seems possible that he may have obtained *Fallax dalliniformis* as well as *Dallina septigera*.

Sars (1878, p. 11 and pl. I, fig. 2), under the name *Waldheimia septata*, gave good figures of the entire shell in dorsal, lateral and frontal view and also the brachial valve in ventral and side view. From the two latter views in particular it is evident that Sars was dealing with *Dallina septigera*: the hinge plates run in a V to the septum and the loop is attached to the crura only, while the descending and ascending branches are joined for but a short distance anteriorly. The crural processes end in characteristic slender curved points.

He gave the length as 36 mm: the adult he figured was somewhat longer than broad.

Davidson in his Linnean Society Monograph (1886) again described *D. septigera* (= *Waldheimia septigera*). He repeated that the deltidium was in two pieces, but omitted his earlier statement concerning well-defined beak ridges. He reproduced some of Sars's figures, but gave a new one of the ventral view of the adult loop (pl. 11, fig. 4) and added an anterior view (pl. 11, fig. 6). The figures show that the adult loop is attached to the crura only and is therefore not that of *Fallax dalliniformis*. Moreover, he stated (p. 57): 'the connection between the process of the lamellae and the septum is severed in a specimen 6 lines in length, and in a specimen 8 lines in length the lamellae are separated and the character of the loop is that of adult *Waldheimia*'. He gave the length as 1 in. 8 lines, that is approximately 42 mm.

Davidson (1886), in discussing Jeffreys' mistaken naming of *Dallina septigera* as *Terebratula septata* Philippi, mentioned that Seguenza had examined the perfect loop in several adult examples of Philippi's *T. septata* from the Pliocene and found it to be three times attached. Thomson (1927, p. 251) placed *septata* in his new genus *Japanithyris*.

Mr G. F. Elliott most kindly examined all the specimens of '*Dallina septigera*' in the British Museum (Natural History) and from his description there is evidently a mixture of *D. septigera* and *Fallax dalliniformis*, but the specimens of the latter may have been added since Davidson's time.

As already mentioned (Atkins, 1960) it seems clear that Fischer & Oehlert (1891) had both *Dallina septigera* (called by them *Magellania septigera*) and its accompanying homoeomorph, and that their description is compounded of characters of the two. Of their figures on pl. iv, fig. 9*aa*, *ab* of the brachial valve of a specimen of shell length 14 mm is almost certainly *Fallax dalliniformis*, and it is possible that fig. 9*r–u*, exterior views of a shell, is also. Fig. 9*x–z* is the loop of *Dallina septigera*, but although it would seem by the dotted line connecting fig. 9*x* and 9*y* that *y* is the loop of *x* enlarged, yet although 9*x* shows the V-shaped meeting of hinge plates with septum, fig. 9*y* shows the meeting T-shaped; this is perhaps the artist's error; in this figure there is also some appearance of transverse connecting bands between the descending branches and the septum, almost obliterated, whether intentionally or not, by shading. On pl. v, fig. 9*ac* of the loop of a specimen 25 mm long is almost certainly of *Fallax dalliniformis*.

Certain of the statements of Fischer & Oehlert apply to *Dallina septigera* only, namely: (1) 'il n'existe ni doublure sous-apicale...' in the ventral valve; (2) 'plateau cardinal...acuminé en avant'; (3) 'mince septum médian'; and (4) loop connected to crura only as in their pl. iv, fig. 9*x* and *z*.

Their statement that the 'dents sont supportées, chez les jeunes, par des cloisons rostrales, qui s'atténuent avec l'âge et disparaissent complètement

chez l'adulte' needs confirmation. In *D. septigera* dredged by R.V. 'Sarsia' dental plates are absent from a shell length of at least 11·5 mm, whereas in *Fallax dalliniformis* they are present at all the sizes obtained.

Fischer & Oehlert (1891, p. 69) mentioned that they had several times found the 'terebratelliforme' stage in individuals of large size appearing fully adult. These were almost certainly *F. dalliniformis* Atkins, 1960.

Thomson (1927, pp. 252–3) evidently based his description of *Dallina septigera* at least partly on that of Fischer & Oehlert (1891, pp. 64–71) and therefore mentioned certain characters absent in *D. septigera* but present in its homoeomorph *Fallax dalliniformis*. The description of *Dallina septigera* given here is based on Thomson, omitting those characters which belong to *Fallax dalliniformis* and emphasizing those which distinguish it from the latter species.

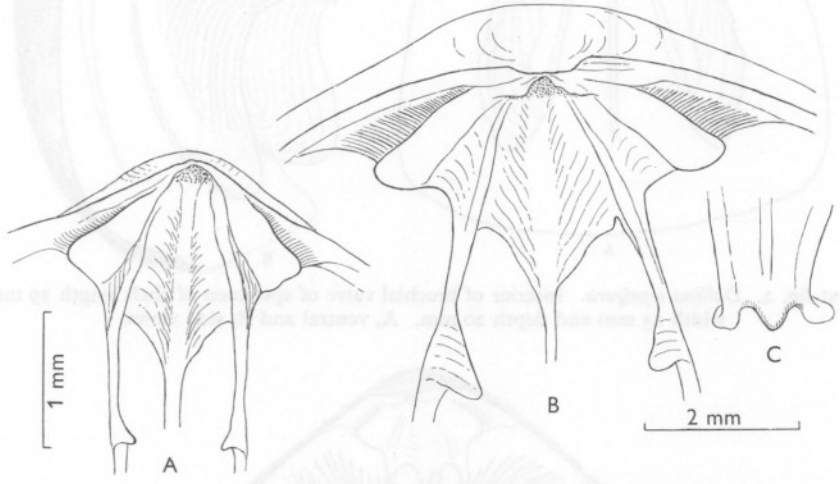
The presence of dental plates is said to be characteristic of the Dallininae, but as Thomson (1927, p. 178) remarked in a footnote *Dallina* itself is an apparent exception, although—evidently following Fischer & Oehlert (1891)—he stated that they were present in the young stages of *D. septigera*, but absent in adolescence (p. 238). Hatai (1940, pp. 316–18, 319, 320–21, 322) noted the absence of dental plates in *D. raphaelis* (Dall), *D. raphaelis albida* (Dall), *D. obessa* Yabe and Hatai and *D. elongata* Hatai. He (p. 320) omitted to mention their absence in *D. triangularis* Yabe and Hatai, but inferred it by saying 'interior features as in *D. raphaelis*'. Dall (1921, p. 359) had previously remarked of *D. floridana* 'there are no props to the dental plates nor septum in the pedicle valve'. This is difficult to follow unless he intended to write there are no props to the teeth. Hatai (1940) in his description of Japanese species of *Dallina* noted the large complete circular foramen, although in *D. raphaelis albidus* it was said to be somewhat transverse. In *D. raphaelis*, *D. raphaelis albidus* and *D. elongata* he described a short sessile striate pedicle collar, but omitted mention of this in *D. obessa* and *D. triangularis*, although it is implied in the latter. All the Japanese species have a symphytium with or without a raised median ridge.

All figures have been drawn with the aid of a camera lucida.

Dallina septigera (Lovén)

Shell large, very variable in shape, generally subpentagonal, broadest anteriorly (Pl. 1, fig. 2A–D), but varying from elongate triangular (Pl. 1, fig. 1A–D) to equilateral triangular, in which the width may slightly exceed the length (Pl. 1, fig. 3A–D). Hinge-line curved, shell broadly sulcate to intraplicate, test thin, smooth. Beak prominent, erect, without beak ridges, foramen large, *circular*, complete, ?mesothyrid, attrite. Symphytium with raised median ridge: it is complete at a shell length of 11·5 mm and possibly earlier. *Hinge teeth unsupported by dental plates*, at least from a shell length of 11·5 mm, the smallest examined, that of 5 mm shell length having been lost; in adults the bases of the teeth somewhat swollen. *Pedicle collar represented merely*

by a narrow inner rim about 1 mm deep. Cardinalia characterized by excavate hinge-plates supported by the median septum, and separable into inner and outer hinge plates by the crural bases, which are not united laterally with the socket ridges (Text-fig. 1A, B and Thomson, 1927, fig. 26). In a large specimen of shell length 27 mm, width 28 mm and depth 20 mm (Text-fig. 3) the hinge-plates were only slightly excavate. *The anterior edges of the inner hinge-plates form a long* V *with the septum.* Cardinal process absent in the young, tendons of diductor muscles attached in a rounded depression (Text-fig. 1A): in adults the area of attachment consists of a median depression with on each side a small elevation (Text-fig. 1B), the end of the tendon being tripartite (Text-fig. 1C). Median septum thin, fairly high posteriorly, gradually lessening in height anteriorly, and extending forward to three-quarters the length of the valve. *Adult loop dalliniform*, attached to the crura only, extending

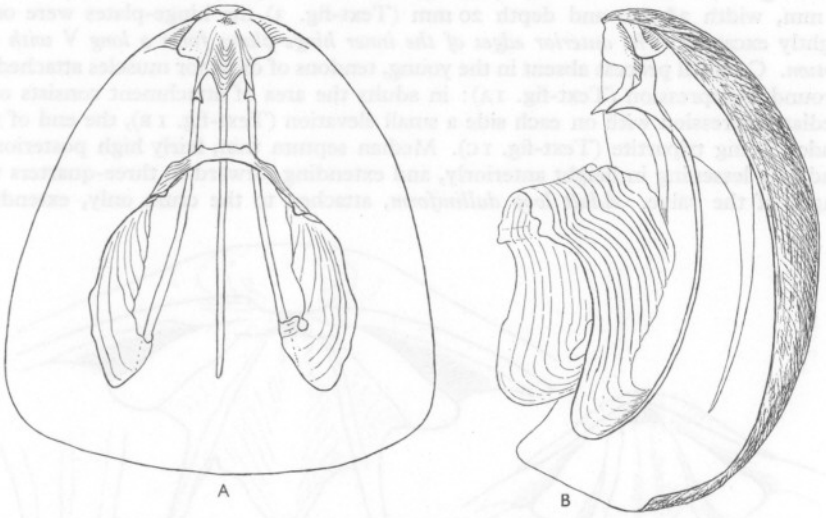


Text-fig. 1. *Dallina septigera.* Cardinalia of two specimens: A, of shell length 11·5 mm, width 10 mm; B, of shell length 24 mm, width 21·5 mm; C, dorsal end of tendons of diductor muscles removed from specimen shown in B.

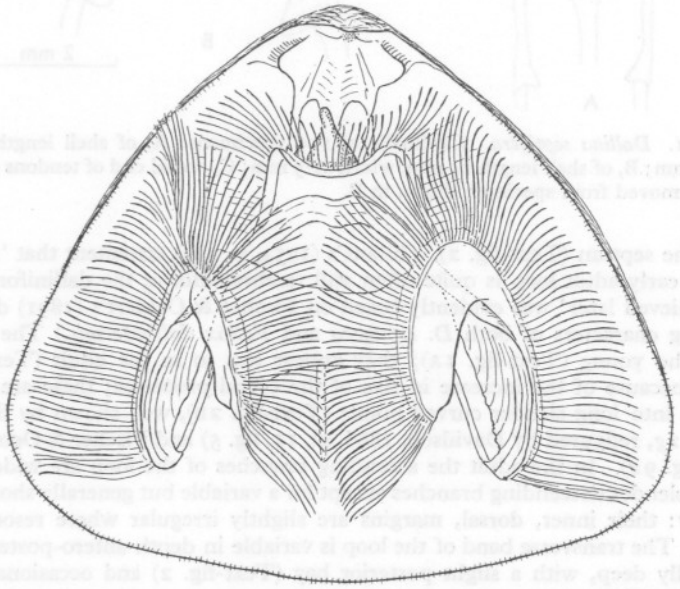
beyond the septum (Text-fig. 2). (Elliott's (1953, p. 269) statement that 'in *Dallina* itself the early adult loop is quite often still terebrataliform, the dalliniform pattern being achieved later' was evidently based on Fischer & Oehlert's (1891) description combining characters of both *D. septigera* and *Fallax dalliniformis*.) The crura are long in the young (Text-fig. 1A); they appear less so in the adult (Text-fig. 1B) possibly because of the increase in size of the crural processes; these are large and produced into long slender curved points (Text-fig. 2B), well shown by Sars (1878, pl. 1, fig. 2*g*, refigured by Davidson, 1886, pl. 11, fig. 5) and Fischer & Oehlert (1891, pl. IV, fig. 9*z*). In the adult the ascending branches of the loop are wide, but free from the slender descending branches except for a variable but generally short distance anteriorly: their inner, dorsal, margins are slightly irregular where resorption has occurred. The transverse band of the loop is variable in depth antero-posteriorly, but is generally deep, with a slight posterior bay (Text-fig. 2) and occasionally a pronounced anterior one.

Muscular impressions not strongly marked. Four pallial sinuses present in each valve. Adult lophophore plectolophous (Text-fig. 3), with nineteen to twenty-four

filaments in single series behind the mouth. The specimen figured is one of two in which the width slightly exceeded the length. Spicules mostly absent, when present are minute and widely scattered (Atkins, 1960).



Text-fig. 2. *Dallina septigera*. Interior of brachial valve of specimen of shell length 29 mm, width 25 mm and depth 20 mm. A, ventral and B, side views.

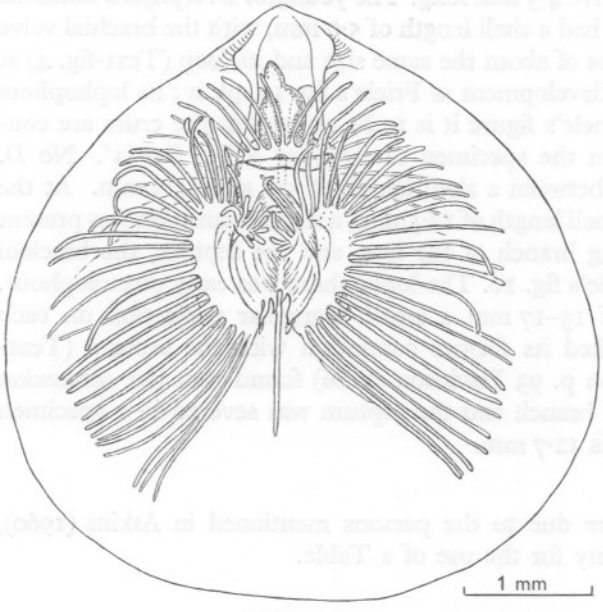


Text-fig. 3. *Dallina septigera*. Brachial valve with plectolophous lophophore of male individual of shell length 27 mm, width 28 mm and depth 20 mm: one of two specimens obtained in which the width exceeded the length.

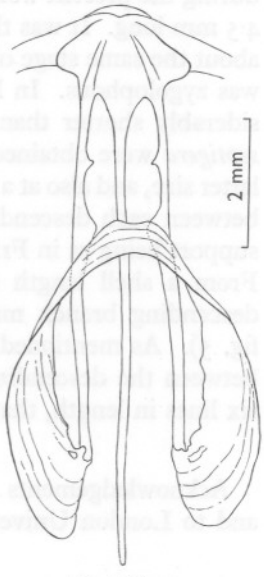
Dallina septigera agrees with *Macandrevia cranium* (Müller) and *Fallax dalliniformis* in lacking the two carmine pigment spots found in certain other brachiopods in connexion with the preoesophageal ganglion.

The ciliary feeding mechanism is as described for *Macandrevia cranium* by Atkins (1956).

The largest specimen obtained was 31 mm long, 25 mm wide and 20 mm deep: it came from position 47° 37′ N., 7° 27′ W. at a depth of 395 fathoms.



Text-fig. 4



Text-fig. 5

Text-fig. 4. *Dallina septigera*. Brachial valve with zygolophous lophophore of specimen of shell length 5 mm (brachial valve 4·5 mm long). The lip is turned forwards exposing the mouth.

Text-fig. 5. *Dallina septigera*. Ventral view of loop of specimen of shell length 13 mm and width 11·5 mm.

Two specimens in which the width slightly exceeded the length had the following dimensions: (1) 27 mm long, 28 mm wide, 20 mm deep (Pl. 1, fig. 3); (2) 23 mm long, 24 mm wide, 15 mm deep.

Breeding. In the seven *Dallina septigera* (shell length 12·5–26 mm) obtained in June 1956 and the single specimen of May 1957 (shell length 24 mm) the gonads were too immature for the sex to be determined without sectioning. Of those obtained in November 1958, twenty-four were examined for sex: ten (shell length 18–27 mm) were males, tailed sperm being present in all; three (shell length, 23, 24, 25 mm) had the gonad well developed. Four (shell length 16–24 mm) were females; two of these (shell length 16 and

24 mm) had large rounded eggs. In ten individuals (length 11·5–22 mm) no gonad could be discerned. Most of the *D. septigera* of July 1959 had the gonad visible through the shell, but in those examined sex products were immature.

GROWTH STAGES OF THE LOPHOPHORE

A number of growth stages of the loop were figured by Friele (1877), the smallest with brachial valve 4·5 mm long. The youngest *D. septigera* obtained during the present work had a shell length of 5·0 mm, with the brachial valve 4·5 mm long. It was thus of about the same size and its loop (Text-fig. 4) at about the same stage of development as Friele's fig. 12, pl. iv; its lophophore was zygolophous. In Friele's figure it is to be noted that the crura are considerably shorter than in the specimen dredged by R.V. 'Sarsia'. No *D. septigera* were obtained between a shell length of 5·0 and 11·5 mm. At the latter size, and also at a shell length of 12·5 mm, a slight connexion was present between each descending branch of the loop and the septum, the brachial support being as in Friele's fig. 16. The lophophore was early plectolophous. From a shell length of 13–17 mm a small triangular projection on each descending branch marked its former connexion with the septum (Text-fig. 5). As mentioned on p. 93 Davidson (1886) found that the connexion between the descending branch and the septum was severed in a specimen six lines in length, that is 12·7 mm.

Acknowledgements are due to the persons mentioned in Atkins (1960), and to London University for the use of a Table.

SUMMARY

Following the discovery of a homoeomorph, *Fallax dalliniformis* Atkins 1960, of *Dallina septigera* (Lovén) occurring with that species and confused with it by Fischer & Oehlert, *D. septigera* has been redescribed.

EXPLANATION OF PLATE I

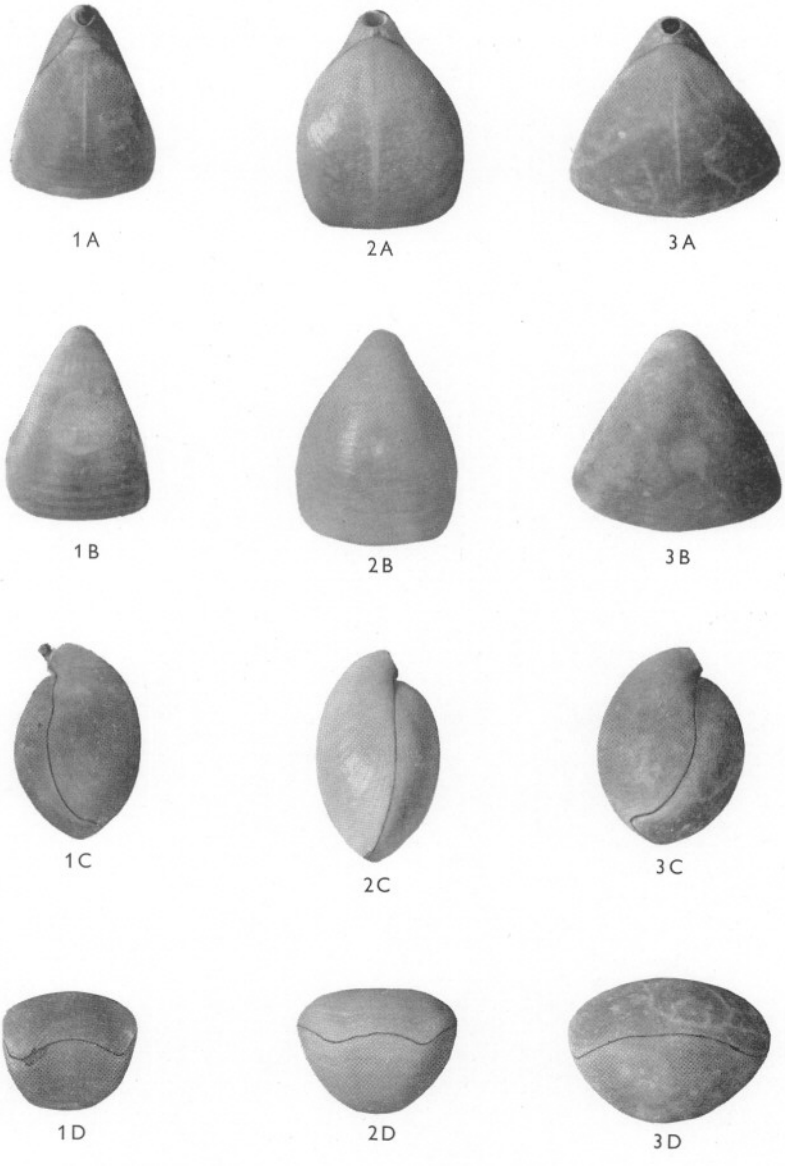
Dallina septigera (Lovén), to show variation in shape.

Fig. 1, A–D. Dorsal, ventral, lateral and frontal views of specimen 26 mm long, 18 mm wide and 17 mm deep, from position 48° 39′–38′ N., 9° 45′–50′ W.; depth 580–510 fathoms. The light circular area on the pedicle valve marks the former position of a *Verruca*.

Fig. 2, A–D. Dorsal, ventral, lateral and frontal views of a specimen 29 mm long, 22 mm wide and 18 mm deep from the Stockholm Natural History Museum. Locality Norway and North Sea. The symphytium had evidently been injured and later repaired by the animal.

Fig. 3, A–D. Dorsal, ventral, lateral and frontal views of specimen 27 mm long, 28 mm wide and 20 mm deep, from position 48° 32′–33′ N., 10° 10′–09′ W.; depth 375–490 fathoms.

Figs. 1 and 3 photographed while in water; Fig. 2 photographed dry. Approximately natural size.



(*Facing p.* 98)

REFERENCES

ATKINS, D., 1956. The ciliary feeding mechanisms of brachiopods. *Nature, Lond.*, Vol. 177, pp. 706–7.

—— 1960. A new species and genus of Brachiopoda from the Western Approaches, and the growth stages of the lophophore. *J. mar. biol. Ass. U.K.*, Vol. 39, pp. 71–89.

DALL, W. H., 1871. Report on the Brachiopoda obtained by the United States coast survey expedition, in charge of L. F. de Pourtalès, with a revision of the Craniidae and Discinidae. *Bull. Mus. comp. Zool. Harvard*, Vol. 3, pp. 1–45.

—— 1921. Annotated list of the recent Brachiopoda in the collection of the United States National Museum, with descriptions of thirty-three new forms. *Proc. U.S. nat. Mus.*, Vol. 57, pp. 261–377.

DAVIDSON, T., 1855. *Waldheimia septigera* Lovén sp. *Ann. Mag. nat. Hist.*, Ser. 2, Vol. 16, pp. 441–2.

DAVIDSON, T., 1886. A monograph of recent Brachiopoda. Part I. *Trans. Linn. Soc. Lond.* (*Zool.*), Ser. 2, Vol. 4, pp. 1–74.

ELLIOTT, G. F., 1953. Brachial development and evolution in terebratelloid brachiopods. *Biol. Rev.*, Vol. 28, pp. 261–79.

FISCHER, P. & OEHLERT, D.-P., 1891. Brachiopodes. *Expéd. sci. Travailleur et Talisman*, 140 pp.

FRIELE, H., 1877. The development of the skeleton in the genus *Waldheimia*. *Arch. Math. Naturv.*, Bd. 2, pp. 380–6.

GRAY, J. E., 1853. *Catalogue of the Mollusca in the Collection of the British Museum. Pt. IV. Brachiopoda Ancylopoda or Lamp Shells.* London.

HATAI, K. M., 1940. Cenozoic Brachiopoda from Japan. *Sci. Rep. Tôhoku Univ.* (2 Geol.), Vol. 20, pp. 1–413.

JEFFREYS, J. G., 1878. On the Mollusca procured during the 'Lightning' and 'Porcupine' Expeditions, 1868–70. (Part I.) *Proc. zool. Soc. Lond.*, 1878, pp. 393–416.

LOVÉN, S., 1846. Nordens Hafs-Mollusker. Index Molluscorum litora Scandinaviae occidentalia habitantium. *Öfvers. VetenskAkad. Förh., Stockh.*, Bd. 3, pp. 134–60, 182–204.

SARS, G. O., 1878. *Bidrag til kundskaben om Norges arktiske Fauna. I. Mollusca regionis arcticae Norvegiae.* Christiania.

THOMSON, J. A., 1927. Brachiopod morphology and genera (Recent and Tertiary). *N.Z. Bd. Sci. Art*, Manual 7.